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Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2011-000400
Article Type:	Research
Date Submitted by the Author:	18-Nov-2011
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Occupational and environmental medicine, Rehabilitation medicine
Keywords:	PUBLIC HEALTH, REHABILITATION MEDICINE, OCCUPATIONAL & INDUSTRIAL MEDICINE, EPIDEMIOLOGY

Factors predicting work status three months after injury: results from the Prospective Outcome of Injury Study

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Counts: main text 3234 words; abstract 246 words; figures 0; tables 3; appendices 1

Key words: Wounds and injuries; work; rehabilitation, vocational; cohort study.

ABSTRACT

Objective: Few studies examine predictors of work status following injury beyond injuries presenting to a hospital or emergency department. This paper examines the combined influences of socio-demographic, occupational, injury, and pre-existing health and lifestyle factors as predictors of work status three months after hospitalised and non-hospitalised injury in a cohort of injured New Zealand workers.

Methods: Workforce active participants (n=2626) were identified from the Prospective Outcomes of Injury Study, a cohort study of injured people registered with New Zealand's national no-fault insurance agency. Seven dimensions were considered: six pre-injury dimensions (socio-demographic, physical work, psychosocial, work organisation, lifestyle, health) plus an injury-related dimension. The outcome of interest was 'not working' at the time of interview. Multivariable logistic regression models were built for each of the seven dimensions and an overall multi-dimensional model.

Results: 720 (27%) reported 'not working' three months after injury. Multidimensional modelling found the most important pre-injury predictors of not working following injury were: low or unknown income, financial insecurity, physical work tasks, temporary employment, long-week schedules, obesity, perceived threat to life and hospital admission. Contrary to expectations, workers reporting less frequent exercise pre-injury had lower odds of work absence. Pre-injury psychosocial and health factors were not associated with not working.

Conclusion: Certain pre-injury socio-demographic, physical work, work organisation, lifestyle and injury-related factors were associated with not working three months after injury. If these findings are confirmed, intervention strategies aimed at improving return to work should address multiple dimensions of both the worker and workplace.

BACKGROUND

A timely and sustainable return to work is a crucial rehabilitation outcome for workers following injury, as prolonged work absences result in significant personal and societal costs.[1 2] Many studies investigating factors associated with work status following injury are restricted to particular injury types or body regions.[3-6] Others have primarily focused on injuries resulting in a hospital emergency department visit or admission.[3 4 7-13] Few studies have examined work status following injury outside a hospital recruitment setting.[14 15] However when considering the total burden of injury, many seemingly "minor" injuries that do not result in hospitalisation, such as soft tissue injuries, can result in substantial time away from the workplace for rehabilitation and recovery.

Researchers investigating return to work following injury have utilised different times to follow-up and different risk factors, outcome measures, and sample populations. However, despite these differences socio-demographic, clinical and occupational factors have tended to be been found to determine work status following injury.[16-18] The need for broader examination of potential determinants of work status using a bio-psychosocial perspective in the trauma population was recently highlighted.[18] For example, pre-injury health and lifestyle factors associated with return to work following lower back pain[19] have rarely been examined and there has been limited examination of potential psychosocial risk factors following injury.[18] In New Zealand, research appears to have been limited to examining time on compensation in workers with chronic back pain.[20]

New Zealand's universal no-fault compensation scheme (administered by the Accident Compensation Corporation – ACC) provides the opportunity to examine determinants of work status for workers with

compensated injuries sustained in a broader context. The aim of this paper is to examine the combined influences of socio-demographic, occupational, pre-existing health and lifestyle factors and injury, as predictors of work status three months following injury in a cohort of injured New Zealand workers.

METHODS

Study setting

The Prospective Outcomes of Injury Study (POIS) cohort was recruited via New Zealand's no-fault Accident Compensation Corporation scheme. POIS participants include those who consulted with a primary or secondary health care professional for an injury, and then consequently, were placed on the Accident Compensation Corporation's entitlement claims register. This register is comprised of people with an injury likely to require more than acute treatment only. For example, people likely to require a week or more off work or home support and/or rehabilitation are placed on this register. POIS participant's injuries were variously sustained in recreational, road, home, public, and workplace settings. Injured people living in one of five regions of New Zealand aged 18-65 years, who had sustained an injury between June 2007 and May 2009, identified via the Accident Compensation Corporation scheme entitlement claims register were eligible for inclusion. The recruitment process and resulting cohort has been described in detail elsewhere.[21 22]

Data collection and explanatory variables

Between December 2007 to August 2009, 2856 participants were recruited.[22] Of these, 2626 (92%) responded they were working for pay ('workforce active') prior to their injury, and they are the cohort

presented in this paper. Self-reported data, including pre-injury characteristics were mainly collected by telephone interview (89%) and postal survey (11%), on average, three months following injury.

All explanatory variables are pre-injury measures, with the exception of the injury-related variables which relate to the injury event itself. Each explanatory variable was selected on the basis of an a priori hypothesis of a relationship with not working following injury, and/or having been identified in previous studies.[18 19] These measures, assessed at interview, have been grouped into seven dimensions:

1) socio-demographic (age, gender, income, highest qualification, occupation, relationship status, living arrangements, material standard of living, adequacy of household income, financial security);

2) physical work (repetitive hand movements, heavy lifting, physical exertion, standing, or working in painful/tiring body positions);

3) psychosocial (job strain, job support, job security, job satisfaction, optimism, self-efficacy, prior depressive episode);

4) work organisational (hours of work, number of days worked per week, employment contract, multiple job holding) ;

5) lifestyle (alcohol consumption, current smoking status, Body Mass Index (BMI), exercise, sleep quantity);

6) health (overall self-assessment for health, co-morbidities, pain or discomfort, prior injury, prior disabling condition, work capacity);

7) injury-related (work-related injury, intent of injury, hospital admission, injury a threat to life, injury a threat of serious disability, access to health services).

For more detailed information about the explanatory variables, see the online appendix 1.

Outcome

Work status was assessed using a single item "*Are you back at work following your injury?*" (yes, no). A participant was considered to be working at time of interview, regardless of whether they were working with their pre-injury employer, a new employer or working under modified working conditions, such as reduced work hours. The majority (82%) of the cohort have had a week, or more, off work and received earnings-related compensation from the Accident Compensation Corporation scheme. The remainder may have had less time off work or been ineligible for earnings-related compensation. Not being in work at the time of interview is referred to in this paper as not working.

Data analysis

Frequency tables, summary statistics and binary logistic regression analyses were used to examine the relationship between not working and pre-injury characteristics and injury-related factors.

Initially dimensional models were built using multivariable logistic regression analyses of all study variables within each of the seven dimensions simultaneously entered into individual models. Age, gender, hospital admission, body region injured, and nature of injury were included in all models as potential confounders. Based upon participants' descriptions body region injured (lower extremities; upper extremities; head and neck; spine and back; torso; and multiple body regions) and nature of injury (fractures; sprains and strains; concussion; open wound/amputations; contusion/superficial; other single injury type; and multiple injury types) were assigned using a modified version of the Barell Matrix.[23] Time since injury was included as a continuous variable into all analyses to account for the range in the timing of interviews after the injury event.

An overall multidimensional model was built by entering explanatory variables from each of the seven dimension models showing an association of $p<0.20$ with not working as independent variables. Backward stepwise elimination (criteria $p<0.10$) was used to select the final variables for inclusion. Post-hoc testing of model using the Hosmer and Lemeshow goodness of fit test and area under the curve was undertaken to assess model fit. Analyses were performed using STATA statistical package 11.1.

Ethics

Ethical approval for this study was obtained from the New Zealand Multi-Region Ethics Committee. Informed consent was obtained from all participants.

RESULTS

Of the 2626 POIS participants who were workforce-active pre-injury, 11 were missing responses to the work-status question at the 3 month post injury survey and were excluded from this investigation. Of the remaining 2615 workers, 720 (27%) reported not working at the time of interview (median time to interview was 3.4 months after injury; interquartile range: 2.5 to 4.1 months).

The mean age of participants was 41 years (SD 13 years). The majority of the cohort are male (63%), had post-secondary qualifications (60%), and were employees (85%)(see online table 1). The median annual personal income was $45,000. Annual personal income was not provided by 16% of participants. The predominant injury type was multiple injury types (39%), followed by sprains and strains (26%) and fractures (17%). The lower (37%) and upper extremities (28%) were the most

frequent body regions injured, followed by multiple injury regions (18%). Thirty percent of the cohort reported hospital admission, while a further 36% reported attending an Emergency Department (without hospital admission).

Table 2 shows the dimension-specific multivariable analyses in relation to not working three months after injury. The following pre-injury variables had p-values <0.20 in the dimension-specific logistic regression modelling:

sociodemographics (age, gender, highest qualification, income, occupation, relationship status, adequacy of household income, financial security);

physical work (repetitive hand movements, heavy lifting, painful/tiring body positions, standing);

psychosocial (job strain, job support, job security, prior depressive episode);

work organisational (hours of work, number of days worked per week, employment contract);

lifestyle (current smoking status, BMI, exercise, sleep quantity);

health (co-morbidities, prior injury, pain or discomfort); and

injury-related (work-related injury, injury a threat to life, intent of injury, hospital admission).

In order to identify the strongest predictors of not working across all dimensions, all these variables were entered in a multivariable logistic regression analysis.

Table 2: Dimension level multivariable analyses for not working three months after injury.

Dimension Model Variable	**Adjusted* odds ratio (95% CI)**	**p-value**
Model 1: Pre-injury socio-demographic factors (n=2368)		

Age		
18-24	Ref	0.05
25-34	0.72 (0.49 to 1.05)	
35-44	1.12 (0.77 to 1.63)	
45-54	1.07 (0.73 to 1.57)	
55-64	0.94 (0.62 to 1.42)	
Gender		
Male	Ref	0.2
Female	0.87 (0.69 to 1.11)	
Highest qualification		
Post secondary qualifications	Ref	0.01
Secondary qualifications	0.98 (0.77 to 1.24)	
No formal qualifications	1.44 (1.09 to 1.89)	
Income		
≥$50,001	Ref	<0.001
$30,001-$50,000	1.24 (0.95 to 1.61)	
≤ $30,000	1.81 (1.33 to 2.48)	
No income given	2.24 (1.63 to 3.07)	
Occupation		
White collar	Ref	<0.001
Pink collar	1.26 (0.94 to 1.68)	
Blue collar	2.15 (1.65 to 2.81)	

Unclassified	1.14 (0.59 to 2.17)	
Relationship Status		
Married/De Facto/Civil Union	Ref	0.1
Never married	1.17 (0.84 to 1.62)	
Separated/Divorced	1.34 (0.92 to 1.94)	
Widowed	2.19 (0.94 to 5.12)	
Living arrangements		
Living alone	Ref	0.3
Living with familial other	1.31 (0.87 to 1.96)	
Living with non-familial other	1.37 (0.84 to 2.22)	
Adequacy of household income		
Sufficient	Ref	0.1
Insufficient	1.17 (0.94 to 1.47)	
Material standard of living		
High/Fairly high	Ref	0.4
Medium	1.08 (0.87 to 1.35)	
Fairly low/Low	0.82 (0.49 to 1.35)	
Financial security		
Secure/Fairly secure	Ref	<0.001
Fairly insecure/Insecure	1.55 (1.22 to 1.96)	
Model 2: Pre-injury physical work factors (n=2509)		
Repetitive hand movements		

Never	Ref	0.09
Occasionally/sometimes	0.78 (0.55 to 1.13)	
¼ to ½ the time	0.77 (0.55 to 1.06)	
¾ of time or greater	1.03 (0.78 to 1.36)	
Heavy lifting		
Never	Ref	0.05
Occasionally/sometimes	1.29 (0.98 to 1.72)	
¼ to ½ the time	1.37 (0.99 to 1.89)	
¾ of time or greater	1.66 (1.15 to 2.38)	
Painful/tiring body positions		
Never	Ref	0.001
Occasionally/sometimes	1.17 (0.91 to 1.51)	
¼ to ½ the time	1.96 (1.44 to 2.65)	
¾ of time or greater	1.61 (1.16 to 2.24)	
Standing		
Never	Ref	>0.001
Occasionally/sometimes	1.65 (1.08 to 2.54)	
¼ to ½ the time	1.32 (0.87 to 1.99)	
¾ of time or greater	2.03 (1.38 to 2.96)	
Physical exertion		
Never	Ref	0.6
Occasionally/sometimes	1.18 (0.88 to 1.59)	

¼ to ½ the time	1.08 (0.78 to 1.49)	
¾ of time or greater	1.19 (0.86 to 1.65)	
Model 3: Pre-injury psychosocial factors (n=2362)		
Job strain		
Low strain	Ref	>0.001
Active	0.88 (0.66 to 1.17)	
Passive	1.37 (1.02 to 1.83)	
High strain	1.52 (1.13 to 2.02)	
Job support		
Quartile 1- High	Ref	0.03
Quartile 2	0.65 (0.46 to 0.94)	
Quartile 3	0.73 (0.57 to 0.94)	
Quartile 4 – Low	0.80 (0.61 to 1.04)	
Job security		
Very secure	Ref	0.03
Secure	1.27 (1.02 to 1.59)	
Insecure/very insecure	1.46 (1.02 to 2.10)	
Job satisfaction		
Completely/mostly satisfied	Ref	0.4
Neither satisfied nor dissatisfied	0.85 (0.61 to 1.20)	
Mostly/completely dissatisfied	0.80 (0.51 to 1.26)	
Self-efficacy		

Good	Ref	0.2
Poor	0.80 (0.56 to 1.14)	
Optimism		
Yes	Ref	0.5
No	1.09 (0.81 to 1.47)	
Prior depressive episode		
No	Ref	0.03
Yes	1.27 (1.02 to 1.59)	
Model 4: Pre-injury work organisational factors (n=2518)		
Hours of work		
≤ 30 hrs	Ref	0.004
31-45 hrs	0.84 (0.63 to 1.14)	
45-65 hrs	0.86 (0.61 to 1.22)	
≥ 66 hrs	1.32 (0.72 to 2.44)	
Number of days worked per week		
≤ 5 days	Ref	>0.001
6-7 days	1.68 (1.31 to 2.15)	
Employment contract		
Employee - permanent	Ref	>0.001
Employee - temporary/casual	2.25 (1.58 to 3.20)	
Employee - fixed term	1.51 (0.98 to 2.35)	
Employee - other contract types	1.50 (0.76 to 2.98)	

Self-employed	1.20 (0.87 to 1.66)	
Employer	0.70 (0.44 to 1.12)	
Multiple job holding		
Yes	Ref	0.8
No	1.04 (0.74 to 1.45)	
Model 5: Pre-injury lifestyle factors (n=2445)		
Alcohol consumption	Ref	0.6
Low	0.95 (0.77 to 1.18)	
High		
Current smoking status		
No	Ref	0.009
Yes	0.76 (0.62 to 0.93)	
Body Mass Index		
≤24	Ref	>0.001
25-29	1.24 (0.99 to 1.56)	
≥30	1.61 (1.26 to 2.05)	
Exercise (days per week)		
5-7 days	Ref	>0.001
≤ 4 days	0.63 (0.52 to 0.76)	
Sleep quantity (per week)		
5-7 nights obtaining ≥7hrs sleep	Ref	0.1
≤ 4 nights obtaining ≥7hrs sleep	0.85 (0.68 to 1.07)	

Model 6: Pre-injury health factors (n=2426)		
Overall self-assessment for health	Ref	0.4
Excellent/Very Good	0.91 (0.73 to 1.13)	
Good/Fair/Poor		
Co-morbidities		
No co-morbidities	Ref	0.06
1 co-morbidities	0.82 (0.66 to 1.04)	
2 or more co-morbidities	1.14 (0.87 to 1.48)	
Prior injury		
No	Ref	0.1
Yes	0.82 (0.63 to 1.06)	
Prior disabling condition		
No	Ref	0.7
Yes	1.04 (0.77 to 1.40)	
Pain or discomfort		
None	Ref	0.1
Moderate	1.00 (0.70 to 1.43)	
Extreme	3.46 (0.93 to 12.78)	
Work capacity		
High (≥7)	Ref	0.9
Low (<7)	1.01 (0.48 to 2.11)	
Model 7: Injury-related factors (n=2509)		

Work-related injury		
No	Ref	>0.001
Yes	1.46 (1.21 to 1.78)	
Intent of injury event		
No	Ref	0.07
Yes – assaultive	1.55 (0.96 to 2.50)	
Injury a threat to life		
No	Ref	>0.001
Yes/Maybe	1.94 (1.45 to 2.58)	
Injury a threat of serious disability		
No	Ref	0.9
Yes/Maybe	1.00 (0.82 to 1.21)	
Hospital admission		
No	Ref	
Yes	1.74 (1.42 to 2.13)	>0.001
Access to health services		
No difficulties accessing	Ref	
Difficulties accessing	0.95 (0.70 to 1.29)	0.7

*All dimension-level models were adjusted for age, gender, hospital admission, body region injured, nature of injury & time since injury.

Table 3 presents the overall multidimensional logistic regression model identifying the strongest (as defined by the variable p-value <0.10) predictors of not working 3 months after injury. Several socio-

demographic factors were associated with greater odds of not working including: workers with a low personal income; those who gave no income; workers with a blue collar occupation and those reporting financial insecurity. While age was significantly associated with not working as a term, no individual age category was at significantly higher odds of not working compared to the reference of 18-24 year olds. Physical work conditions associated with increased odds of not working included those working in painful/tiring, or standing positions at work. Unlike the bivariate analysis, the association between not working and repetitive hand movements was not significant in the physical work factor model, however it remains in the overall multi-dimensional model as it fits the backwards stepwise elimination criteria ($p<0.10$). Several work organisational factors were associated with greater odds of not working: workers with temporary/casual employment contracts compared to those with permanent contracts and workers with long-week work schedules compared to those working ≤5 days.

Table 3: Significant independent predictors of not working three months following injury. (n=2250)

Explanatory variable	**Work absent** ***n=609*** **N**	**Adjusted * odds ratio**	**95% CI**	**p-value**
Sociodemographic: Age				
18-24	95	Ref		0.004
25-34	96	0.73	0.50 to 1.07	
35-44	146	1.23	0.85 to 1.78	
45-54	172	1.33	0.92 to 1.91	
55-64	100	1.28	0.86 to 1.91	

Sociodemographic: Gender				
Male	424	Ref		0.5
Female	185	0.93	0.72 to 1.20	
Sociodemographic: Income				
≥ $50,000	140	Ref		<0.001
$30,001-$50,000	208	1.16	0.88 to 1.53	
≤ $30,000	149	1.52	1.09 to 2.12	
Refused to give income	112	2.11	1.49 to 2.98	
Sociodemographic: Financial security				
Secure/Fairly secure	436	Ref		0.006
Fairly insecure/Insecure	173	1.41	1.10 to 1.80	
Sociodemographic: Occupation				
White collar	146	Ref		0.01
Pink collar	120	1.04	0.76 to 1.42	
Blue collar	331	1.52	1.14 to 2.02	
Unclassified	12	0.96	0.46 to 2.01	
Physical work: Painful/tiring body positions				
Never	216	Ref		<0.001
Occasionally/sometimes	168	1.33	1.01 to 1.74	
¼-½ the time	116	2.12	1.54 to 2.92	
¾ of time or greater	109	1.93	1.38 to 2.72	
Physical work: Standing				

never	42	Ref		<0.001
occasionally/sometimes	66	1.92	1.20 to 3.07	
¼-½ the time	91	1.60	1.03 to 2.49	
¾ of time or greater	410	2.25	1.51 to 3.34	
Physical work: Repetitive hand movements				
never	104	Ref		0.03
occasionally/sometimes	71	0.69	0.46 to 1.02	
¼-½ the time	107	0.76	0.53 to 1.09	
¾ of time or greater	327	1.04	0.76 to 1.42	
Work organisation: Employment contract				
Permanent	410	Ref		0.02
Temporary	64	1.89	1.27 to 2.81	
Fixed term	32	1.43	0.87 to 2.33	
Other or no formal contract	12	1.62	0.73 to 3.59	
Self-employed	62	1.10	0.76 to 1.59	
Employer	29	0.82	0.49 to 1.36	
Work organisation: Number of days worked per week				
≤5 days per week	419	Ref		<0.001
6-7 days per week	190	1.54	1.21 to 1.96	
Lifestyle: BMI				
Under/normal weight (≤24)	193	Ref		0.01
Over weight (25-29)	238	1.18	0.92 to 1.51	

Obese (≥30)	178	1.48	1.13 to 1.94	
Lifestyle: Sleep quantity (nights ≥7hrs sleep)				
5-7 nights	475	Ref		0.06
≤ 4 nights	134	0.79	0.61 to 1.01	
Lifestyle: Exercise (days per week)				
5-7 days	392	Ref		<0.001
≤4 days	217	0.67	0.54 to 0.83	
Injury: Hospital admission				
No	369	Ref		<0.001
Yes	240	2.10	1.66 to 2.64	
Injury: Self-perceived threat to life				
No	505	Ref		<0.001
Yes/Maybe	104	1.90	1.38 to 2.62	

*adjusted for body region injured, nature of injury, time since injury

While the overall Body Mass Index term did not have a significant association with not working in the overall model, obesity was significantly associated with increased odds of not working compared to the reference of normal Body Mass Index. The lifestyle factors of lower pre-injury exercise frequency was associated with reduced odds of not working. The other lifestyle factor pre-injury sleep was not associated with working status but remains in the model as it fits the model criteria. Injury-related factors associated with increased odds of not working that remained in the overall multi-dimensional model were: those workers who perceived their injury was a threat to their life and those who were admitted to hospital following their injury. None of the psychosocial or health factor variables

examined in this study remained in the overall multidimensional model. Diagnostic testing of the overall model indicated goodness of fit was acceptable (χ^2=2279, p=0.13) and the model had good accuracy in correctly discriminating if a worker was absent from work (area under curve=0.76).[24]

DISCUSSION

This paper presents evidence regarding pre-injury predictors of not working three months after injury. The injuries sustained by this cohort were sufficient enough to potentially warrant at least one week of entitlement compensation. The multivariable multidimensional model confirmed a set of important pre-injury predictors of not working three months following injury. Specifically, our analysis confirmed previous findings that certain socio-demographic, work and injury factors predict work status. This study also broadened the focus to examine dimensions rarely examined previously and found work organisation and lifestyle factors were also important predictors of work status. Psychosocial factors were suggested in prior studies to be an important predictor of working after injury [18 17], however, of the pre-injury psychosocial variables examined in this study, none were found to be important in predicting work status. Health-related factors, rarely examined previously, were not found to be important predictors of work status. Our findings further confirm the need for future studies to examine a broader range of determinants and assess the relative importance of these for work disability.[18]

Our findings are consistent with many studies that demonstrate a relationship between work status and economic security,[16-18] with low income workers most likely to be absent from work compared with high income workers. Additionally those who did not provide income for the income variable were more likely to be absent from work. Further descriptive analysis, not presented here, found these workers were most likely to be on employment contracts that result in fluctuating work patterns,

suggesting these workers may find it difficult to provide an estimate of their annual personal income. Financial insecurity, a marker of future economic security, was associated with not working. While financial insecurity is a predictor of health outcomes,[25] there has been little examination of financial insecurity in relation to work status following injury. Financial insecurity is thought to influence mental health outcomes through anxiety generated by feelings of future economic insecurity. [25] This potential pathway needs further examination with regard to work status.

Occupational factors were important predictors of not working in our study. Previous studies using various occupational classification schemes or categorisations across have reported mixed findings regarding occupation.[17 18] In our study, a blue collar occupation had a higher likelihood of not working. Our findings are consistent with previous cohort studies reporting blue collar workers as less likely to have returned to work following injury adding further strength to the evidence for a causal relationship.[17 18] Physical work tasks involving painful/tiring body positions or standing were at increased likelihood of not working. Exposure to physical work tasks or blue collar work in general are commonly associated with an increased risk of not working following injury.[17 18] However, specific ergonomic hazards are rarely examined with regard to work status and our study identifies potentially modifiable workplace ergonomic hazard exposures that are associated with not working.

Aspects of work organisation are rarely examined in injury populations and our study found two important groups of workers at increased likelihood of not working: temporary and long-week workers. Temporary employees have the poorest social and employment protections, working conditions and higher risk of unemployment when compared with the permanent workforce.[26] Our finding that workers with temporary employment were more likely to be not working compared to those in other types of employment possibly reflects difficulties for employees in: retaining their jobs following injury;

negotiating a modified return to work; or in obtaining new employment in a tight labour market. Studies examining long-term sickness absence report lower rates of absence for temporary employees, suggesting poor social protections are a key determinant of sickness absence-taking behaviour.[27 28] Further examination of potential social and material pathways through which temporary employment can impinge upon the return to work process is warranted. Long-week work schedules also predicted not working. While long-week work schedules have not specifically been found to be associated with not working that we are aware of, other non-standard work schedules, such as long-day work schedules, have been reported to disrupt a full return to work following workplace injury.[29]

Our study found obese workers were more likely to not be working three months following injury. Increasingly studies are showing relationships between obesity, and illness-related work disability.[30-32] However, few studies have investigated the impact of pre-injury obesity on work status following injury.[30] Obesity is often associated with a long list of chronic health conditions and while this multivariable analysis examined the presence of co-morbidities, more specific examination is needed to explain our findings.

Contradictory to expectations those who had higher levels of exercise prior to injury were less likely to have returned to work in our study. Our findings differ to those of a study demonstrating those with moderate fitness prior to injury are more likely to have returned to work three months following a whiplash injury.[33] Those workers used to getting regular exercise prior to their injury may have experienced a substantial change in their exercise patterns as a consequence of their injury. Conceivably, they may have to cope with fewer exercise opportunities – with possible impacts on their

ability to work. This may not be occurring to the same extent among workers already used to irregular exercise before injury.

Two injury-related factors were strongly associated with increased odds of not working: workers who perceived that their injury was a threat to their life and those whose injury resulted in hospital admission. While it might be reasonable to explain these observations by considering injury severity, examination of hospital admission and threat to life within our cohort found the two variables were measuring independent effects. Perceived threat to life is strongly associated with post-traumatic stress disorder,[34] and post-traumatic stress disorder has been found to be strongly associated with failure to work following injury [35 36]. Further work to examine potential pathways of effect is required. Our finding that hospital admission predicts not working three months following injury corroborates previous findings in the few studies to include non-hospitalised injuries that report that intensive care admission and length of hospital stay predicts work status.[9]

The findings from our multidimensional analysis of a wide spectrum of injuries indicate interventions to improve opportunities for working in the short-term following injury need to target a broad range factors. As we have found some previously-unreported findings, these will need to be confirmed with additional research. However, our findings indicate some self-reported pre-injury measures of socio-demographic, workplace and lifestyle-related factors could be used to identify individuals with increased odds of not working three months after injury. This paper identifies a number of pre-injury factors which are potentially amenable to primary intervention, such as workplace hazard exposures, obesity and physical exercise. For example, workplace physical activity interventions have been shown to improve worksite outcomes, such as sick leave.[37] If confirmed, our findings would suggest that primary workforce interventions focusing on lifestyle-related factors may contribute to a reduction in

rates of not working three months following injury, as well as contributing to maintaining a healthy and productive workforce.

The strengths of the study include the collection of pre-injury information, large sample size, inclusion of traditionally-conceived 'less severe' non-hospitalised injuries, and the collection and combined multivariable examination of a wide range of potential determinants of work status. Consequently we have found a number of important and previously unreported associations generating new hypotheses for further examination. There are a few limitations to our study. This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently recall bias might occur. However, workers were specifically directed to consider their pre-injury exposures and few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. A further limitation is the design of New Zealand's Accident Compensation Corporation compensation system meaning the findings of this study are potentially not generalisable beyond no-fault compensation systems. The universal nature of the Accident Compensation Corporation scheme also means we cannot examine compensation status. There is moderate evidence that the receipt and extent of compensation has a negative effect upon returning to work following injury in healthcare systems where only certain causes of injury receive compensation, such as those caused by a motor vehicle traffic crash or while at work.[4 38] However, it is a strength of the study that the universal nature of this scheme allows us to examine predictors of work status in the short term in a broader population context of injury and work than previously examined.

In conclusion, this study indicates a number of pre-injury socio-demographic, occupational and lifestyle factors, as well as injury factors, were associated with not working three months after injury in a sample of New Zealand workers. This study confirms that the predictors of work status following injury are multidimensional and that future studies need to examine a broader range of determinants for work disability. If these findings are confirmed, intervention strategies aimed at identifying workers at increased risk of not working and improving work status in the short-term following injury should address multiple dimensions of the worker and workplace.

Article Summary

Article Focus

- Previous examinations of predictors of work status following injury have focused primarily on hospitalised patients and a limited range of risk factors; this study examines multidimensional predictors of work status three months following hospitalised and non-hospitalised injuries.

Key Message

- While previous findings on socio-demographic and work factors were confirmed, a number of rarely-examined variables were associated with increased odds of not working including: obesity, temporary employment, long-day work schedules and financial insecurity.
- Contrary to expectations, workers who were infrequent exercisers prior to injury were more likely to be working after injury.
- This study identified a range of potential predictors of not working that, if causal, help identify workers at increased risk of not working three months after injury. If confirmed, intervention strategies should target these groups to reduce short-term work disability.

Strengths and Limitations

- The strengths of the study include the collection of pre-injury information, large sample size, inclusion of non-hospitalised and hospitalised injuries, and the collection and combined multivariable examination of a wide range of potential determinants of work status. Consequently this study has generated new hypotheses for further examination.
- This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently recall bias might occur. However, few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. The design of New Zealand's universal no-fault injury compensation system may limit the generalisability of study findings beyond similar systems. However, the universal nature of the New Zealand scheme allows the examination of predictors of work status in a broader population context of injury and work than previously examined.

ACKNOWLEDGEMENTS

We are most grateful to the study participants for sharing their information with us. We thank Professor John Langley, Associate Professor Colin Cryer and Natalie Hardaker for helpful comments on an earlier draft of this paper.

FUNDING

This study is funded by the Health Research Council of New Zealand (2007-2013), and was co-funded by the Accident Compensation Corporation, New Zealand (2007-2010) (ID 10/052). Dr Rebbecca Lilley was supported by an Accident Compensation Corporation Early Career Post Doctoral Award (2007-

2010) (ID 07/049). The views and conclusions in this paper are the authors' and may not reflect those of the funders.

The funders of this project provided funding for salary and working expenses and had no input in the study design, data collection, data analysis or interpretation with the sole exception of the Accident Compensation Corporation who provided the initial sampling list.

DATA SHARING

Data sharing will be considered on a case by case basis by application to the research team.

CONTRIBUTORSHIP

RL was invovled in the design of the data collection tools, cleaned and analysed the data, interpreted the data, drafted and revised the paper. RL is guarantor. GD cleaned the data, provided statistical advice, interpreted the data and critically reviewed the paper. AS was involved in the initiation and design of the study, data interpretation and critically revised the paper. SD designed and implemented the study, managed data collection, interpreted the data, and critically reviewed the paper.

COMPETING INTERESTS

None declared

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STROBE Statement—checklist of items that should be included in reports of observational studies

Checklist for: "Factors predicting work status 3 months after injury: results from the Prospective Outcome of Injury Study" Lilley R, Davie G, Ameratunga S, Derrett S.

	Item No	Recommendation	Author Check
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes
Objectives	3	State specific objectives, including any prespecified hypotheses	Yes
Methods			
Study design	4	Present key elements of study design early in the paper	Yes
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Yes
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes
Bias	9	Describe any efforts to address potential sources of bias	Yes
Study size	10	Explain how the study size was arrived at	Reference given
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes
		(*b*) Describe any methods used to examine subgroups and interactions	Yes
		(*c*) Explain how missing data were addressed	Yes
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	N/A

		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes
		(b) Give reasons for non-participation at each stage	Yes
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes
		(b) Indicate number of participants with missing data for each variable of interest	No – can calculate from table
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	Yes
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	Yes
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	N/A
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yes
		(*b*) Report category boundaries when continuous variables were categorized	Yes
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes
Discussion			
Key results	18	Summarise key results with reference to study objectives	Yes
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes

Factors predicting work status three months after injury: results from the Prospective Outcome of Injury Study

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2011-000400.R1
Article Type:	Research
Date Submitted by the Author:	30-Jan-2012
Complete List of Authors:	Lilley, Rebbecca; University of Otago, Injury Prevention Research Unit Davie, Gabrielle; University of Otago, Injury Prevention Research Unit Derrett, Sarah; University of Otago, Injury Prevention Research Unit Ameratunga, Shanthi; University of Auckland
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Occupational and environmental medicine, Rehabilitation medicine
Keywords:	PUBLIC HEALTH, REHABILITATION MEDICINE, OCCUPATIONAL & INDUSTRIAL MEDICINE, EPIDEMIOLOGY

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Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes

Factors predicting work status three months after injury: results from the Prospective Outcome of Injury Study

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Counts: main text 3571 words; abstract 224 words; figures 0; tables 3; appendices 1

Key words: Wounds and injuries; work; rehabilitation, vocational; cohort study.

ABSTRACT

Objective: Few studies examine predictors of work status following injury beyond injuries presenting to a hospital or emergency department. This paper examines the combined influences of socio-demographic, occupational, injury, and pre-existing health and lifestyle factors as predictors of work status three months after hospitalised and non-hospitalised injury in a cohort of injured New Zealand workers.

Design: Prospective cohort study

Setting: The Prospective Outcomes of Injury Study, New Zealand.

Participants: 2626 workforce active participants were identified from the Prospective Outcomes of Injury Study; 11 participants with missing outcome responses were excluded.

Primary and secondary outcome measures: The primary outcome of interest was 'not working' at the time of interview.

Results: 720 (27%) reported 'not working' three months after injury. Multidimensional modelling found the most important pre-injury predictors of not working following injury were: low or unknown income, financial insecurity, physical work tasks, temporary employment, long-week schedules, obesity, perceived threat to life and hospital admission. Contrary to expectations, workers reporting less frequent exercise pre-injury had lower odds of work absence. Pre-injury psychosocial and health factors were not associated with not working.

Conclusion: Certain pre-injury socio-demographic, physical work, work organisation, lifestyle and injury-related factors were associated with not working three months after injury. If these findings are confirmed, intervention strategies aimed at improving return to work should address multiple dimensions of both the worker and workplace.

BACKGROUND

A timely and sustainable return to work is a crucial rehabilitation outcome for workers following injury, as prolonged work absences result in significant personal and societal costs.[1 2] Many studies investigating factors associated with work status following injury are restricted to particular injury types or body regions.[3-6] Others have primarily focused on injuries resulting in a hospital emergency department visit or admission.[3 4 7-13] Few studies have examined work status following injury outside a hospital recruitment setting.[14 15] However when considering the total burden of injury, many seemingly "minor" injuries that do not result in hospitalisation, such as soft tissue injuries, can result in substantial time away from the workplace for rehabilitation and recovery.

Researchers investigating return to work following injury have utilised different times to follow-up and different risk factors, outcome measures, and sample populations. However, despite these differences socio-demographic, clinical and occupational factors are commonly associated with work status following injury.[16-18] The need for broader examination of potential determinants of work status using a bio-psychosocial perspective in the trauma population was recently highlighted.[18] For example, pre-injury health and lifestyle factors associated with return to work following lower back pain[19] have rarely been examined and there has been limited examination of potential psychosocial risk factors following injury.[18] In New Zealand, research appears to have been limited to examining time on compensation in workers with chronic back pain.[20]

New Zealand's universal no-fault compensation scheme (administered by the Accident Compensation Corporation – ACC) provides the opportunity to examine determinants of work status for workers with

compensated injuries sustained in a broader context. The aim of this paper is to examine the combined influences of socio-demographic, occupational, pre-existing health and lifestyle factors and injury, as predictors of work status three months following injury in a cohort of injured New Zealand workers.

METHODS

Study setting

The Prospective Outcomes of Injury Study (POIS) cohort was recruited via New Zealand's no-fault, non-tortious ACC scheme. People were not eligible to participate if their injury was the result of self-harm, or if their injury resulted in their being placed on ACC's sensitive claims register (e.g. sexual assault). POIS participants include those who consulted with a primary or secondary health care professional for an injury, and then consequently, were placed on ACC's entitlement claims register. Each year there are approximately 1.75 million injuries claims in New Zealand.[21] Of these, 7% are placed on an entitlement claimants register because they are likely to require more than simple medical treatment. For example, people likely to require a week or more off work or home support and/or rehabilitation are placed on this register. POIS participant's injuries were variously sustained in recreational, road, home, public, and workplace settings. Injured people living in one of five regions of New Zealand aged 18-65 years, who had sustained an injury between June 2007 and May 2009, identified via the ACC scheme entitlement claims register were eligible for inclusion. The recruitment process and resulting cohort has been described in detail elsewhere.[22 23]

Data collection and explanatory variables

Between December 2007 to August 2009, 2856 participants were recruited.[23] Of these, 2626 (92%) responded they were working for pay ('workforce active') prior to their injury, and they are the cohort presented in this paper. Of the 2626 POIS participants who were workforce-active pre-injury, 11 were missing responses to the work-status question at the 3 month post injury survey and were excluded from this investigation. Of the remaining 2615 workers, 720 (27%) reported not working at the time of interview (median time to interview was 3.4 months after injury; interquartile range: 2.5 to 4.1 months). Self-reported data, including pre-injury characteristics were mainly collected by telephone interview (89%) and postal survey (11%), on average, three months following injury.

All explanatory variables are pre-injury measures retrospectively collected at the 3 month interview, with the exception of the injury-related variables which relate to the injury event itself. Each explanatory variable was selected on the basis of an a priori hypothesis of a relationship with not working following injury, and/or having been identified in previous studies.[18 19] These measures, assessed at interview, have been grouped into seven dimensions:

1) socio-demographic (age, gender, income, highest qualification, occupation, relationship status, living arrangements, material standard of living, adequacy of household income, financial security);

2) physical work (repetitive hand movements, heavy lifting, physical exertion, standing, or working in painful/tiring body positions);

3) psychosocial (job strain, job support, job security, job satisfaction, optimism, self-efficacy, prior depressive episode);

4) work organisational (hours of work, number of days worked per week, employment contract, multiple job holding) ;

5) lifestyle (alcohol consumption, current smoking status, Body Mass Index (BMI), exercise, sleep quantity);

6) health (overall self-assessment for health, co-morbidities, pain or discomfort, prior injury, prior disabling condition, work capacity);

7) injury-related (work-related injury, intent of injury, hospital admission, injury a threat to life, injury a threat of serious disability, access to health services).

For more detailed information about the explanatory variables, see the online appendix 1.

Outcome

Work status was assessed using a single item "*Are you back at work following your injury?*" (yes, no). A participant was considered to be working at time of interview, regardless of whether they were working with their pre-injury employer, a new employer or working under modified working conditions, such as reduced work hours. The majority (82%) of the cohort have had a week, or more, off work and received earnings-related compensation from the ACC scheme. The remainder may have had less time off work or been ineligible for earnings-related compensation. Not being in work at the time of interview is referred to in this paper as not working.

Data analysis

Frequency tables, summary statistics and binary logistic regression analyses were used to examine the relationship between not working and pre-injury characteristics and injury-related factors.

Initially dimensional models were built using multivariable logistic regression analyses of all study variables within each of the seven dimensions simultaneously entered into individual models. Age,

gender, hospital admission, body region injured, and nature of injury were included in all models as potential confounders. Based upon participants' descriptions body region injured (lower extremities; upper extremities; head and neck; spine and back; torso; and multiple body regions) and nature of injury (fractures; sprains and strains; concussion; open wound/amputations; contusion/superficial; other single injury type; and multiple injury types) were assigned using a modified version of the Barell Matrix.[24] Time since injury was included as a continuous variable into all analyses to account for the range in the timing of interviews after the injury event.

An overall multidimensional model was built by entering explanatory variables from each of the seven dimension models showing an association of $p<0.20$ with not working as independent variables. Backward stepwise elimination (criteria $p<0.10$) was used to select the final variables for inclusion. Post-hoc testing of model using the Hosmer and Lemeshow goodness of fit test and area under the curve was undertaken to assess model fit. Analyses were performed using STATA statistical package 11.1.

Ethics

Ethical approval for this study was obtained from the New Zealand Multi-Region Ethics Committee. Informed consent was obtained from all participants.

RESULTS

The mean age of participants was 41 years (SD 13 years). The majority of the cohort are male (63%), had post-secondary qualifications (60%), and were employees (85%)(see online table 1). The median annual personal income was $45,000. Annual personal income was not provided by 16% of

participants. The predominant injury type was multiple injury types (39%), followed by sprains and strains (26%) and fractures (17%). The lower (37%) and upper extremities (28%) were the most frequent body regions injured, followed by multiple injury regions (18%). Thirty percent of the cohort reported hospital admission, while a further 36% reported attending an Emergency Department (without hospital admission).

Table 2 shows the dimension-specific multivariable analyses in relation to not working three months after injury. The following pre-injury variables had p-values <0.20 in the dimension-specific logistic regression modelling:

sociodemographics (age, gender, highest qualification, income, occupation, relationship status, adequacy of household income, financial security);

physical work (repetitive hand movements, heavy lifting, painful/tiring body positions, standing);

psychosocial (job strain, job support, job security, prior depressive episode);

work organisational (hours of work, number of days worked per week, employment contract);

lifestyle (current smoking status, BMI, exercise, sleep quantity);

health (co-morbidities, prior injury, pain or discomfort); and

injury-related (work-related injury, injury a threat to life, intent of injury, hospital admission).

In order to identify the strongest predictors of not working across all dimensions, all these variables were entered in a multivariable logistic regression analysis.

Table 2: Dimension level multivariable analyses for not working three months after injury.

Dimension Model	Adjusted* odds ratio (95% CI)	p-value

Variable		
Model 1: Pre-injury socio-demographic factors (n=2368)		
Age		
18-24	Ref	0.05
25-34	0.72 (0.49 to 1.05)	
35-44	1.12 (0.77 to 1.63)	
45-54	1.07 (0.73 to 1.57)	
55-64	0.94 (0.62 to 1.42)	
Gender		
Male	Ref	0.2
Female	0.87 (0.69 to 1.11)	
Highest qualification		
Post secondary qualifications	Ref	0.01
Secondary qualifications	0.98 (0.77 to 1.24)	
No formal qualifications	1.44 (1.09 to 1.89)	
Income		
≥$50,001	Ref	<0.001
$30,001-$50,000	1.24 (0.95 to 1.61)	
≤ $30,000	1.81 (1.33 to 2.48)	
No income given	2.24 (1.63 to 3.07)	
Occupation		
White collar	Ref	<0.001

Pink collar	1.26 (0.94 to 1.68)	
Blue collar	2.15 (1.65 to 2.81)	
Unclassified	1.14 (0.59 to 2.17)	
Relationship Status		
Married/De Facto/Civil Union	Ref	0.1
Never married	1.17 (0.84 to 1.62)	
Separated/Divorced	1.34 (0.92 to 1.94)	
Widowed	2.19 (0.94 to 5.12)	
Living arrangements		
Living alone	Ref	0.3
Living with familial other	1.31 (0.87 to 1.96)	
Living with non-familial other	1.37 (0.84 to 2.22)	
Adequacy of household income		
Sufficient	Ref	0.1
Insufficient	1.17 (0.94 to 1.47)	
Material standard of living		
High/Fairly high	Ref	0.4
Medium	1.08 (0.87 to 1.35)	
Fairly low/Low	0.82 (0.49 to 1.35)	
Financial security		
Secure/Fairly secure	Ref	<0.001
Fairly insecure/Insecure	1.55 (1.22 to 1.96)	

Model 2: Pre-injury physical work factors (n=2509)		
Repetitive hand movements		
Never	Ref	0.09
Occasionally/sometimes	0.78 (0.55 to 1.13)	
¼ to ½ the time	0.77 (0.55 to 1.06)	
¾ of time or greater	1.03 (0.78 to 1.36)	
Heavy lifting		
Never	Ref	0.05
Occasionally/sometimes	1.29 (0.98 to 1.72)	
¼ to ½ the time	1.37 (0.99 to 1.89)	
¾ of time or greater	1.66 (1.15 to 2.38)	
Painful/tiring body positions		
Never	Ref	0.001
Occasionally/sometimes	1.17 (0.91 to 1.51)	
¼ to ½ the time	1.96 (1.44 to 2.65)	
¾ of time or greater	1.61 (1.16 to 2.24)	
Standing		
Never	Ref	>0.001
Occasionally/sometimes	1.65 (1.08 to 2.54)	
¼ to ½ the time	1.32 (0.87 to 1.99)	
¾ of time or greater	2.03 (1.38 to 2.96)	
Physical exertion		

Never	Ref	0.6
Occasionally/sometimes	1.18 (0.88 to 1.59)	
¼ to ½ the time	1.08 (0.78 to 1.49)	
¾ of time or greater	1.19 (0.86 to 1.65)	
Model 3: Pre-injury psychosocial factors (n=2362)		
Job strain		
Low strain	Ref	>0.001
Active	0.88 (0.66 to 1.17)	
Passive	1.37 (1.02 to 1.83)	
High strain	1.52 (1.13 to 2.02)	
Job support		
Quartile 1- High	Ref	0.03
Quartile 2	0.65 (0.46 to 0.94)	
Quartile 3	0.73 (0.57 to 0.94)	
Quartile 4 – Low	0.80 (0.61 to 1.04)	
Job security		
Very secure	Ref	0.03
Secure	1.27 (1.02 to 1.59)	
Insecure/very insecure	1.46 (1.02 to 2.10)	
Job satisfaction		
Completely/mostly satisfied	Ref	0.4
Neither satisfied nor dissatisfied	0.85 (0.61 to 1.20)	

Mostly/completely dissatisfied	0.80 (0.51 to 1.26)	
Self-efficacy		
Good	Ref	0.2
Poor	0.80 (0.56 to 1.14)	
Optimism		
Yes	Ref	0.5
No	1.09 (0.81 to 1.47)	
Prior depressive episode		
No	Ref	0.03
Yes	1.27 (1.02 to 1.59)	
Model 4: Pre-injury work organisational factors (n=2518)		
Hours of work		
≤ 30 hrs	Ref	0.004
31-45 hrs	0.84 (0.63 to 1.14)	
45-65 hrs	0.86 (0.61 to 1.22)	
≥ 66 hrs	1.32 (0.72 to 2.44)	
Number of days worked per week		
≤ 5 days	Ref	>0.001
6-7 days	1.68 (1.31 to 2.15)	
Employment contract		
Employee - permanent	Ref	>0.001
Employee - temporary/casual	2.25 (1.58 to 3.20)	

Employee - fixed term	1.51 (0.98 to 2.35)	
Employee - other contract types	1.50 (0.76 to 2.98)	
Self-employed	1.20 (0.87 to 1.66)	
Employer	0.70 (0.44 to 1.12)	
Multiple job holding		
Yes	Ref	0.8
No	1.04 (0.74 to 1.45)	
Model 5: Pre-injury lifestyle factors (n=2445)		
Alcohol consumption		
Low	Ref	0.6
High	0.95 (0.77 to 1.18)	
Current smoking status		
No	Ref	0.009
Yes	0.76 (0.62 to 0.93)	
Body Mass Index		
≤24	Ref	>0.001
25-29	1.24 (0.99 to 1.56)	
≥30	1.61 (1.26 to 2.05)	
Exercise (days per week)		
5-7 days	Ref	>0.001
≤ 4 days	0.63 (0.52 to 0.76)	
Sleep quantity (per week)		

5-7 nights obtaining ≥7hrs sleep	Ref	0.1
≤ 4 nights obtaining ≥7hrs sleep	0.85 (0.68 to 1.07)	
Model 6: Pre-injury health factors (n=2426)		
Overall self-assessment for health		
Excellent/Very Good	Ref	0.4
Good/Fair/Poor	0.91 (0.73 to 1.13)	
Co-morbidities		
No co-morbidities	Ref	0.06
1 co-morbidities	0.82 (0.66 to 1.04)	
2 or more co-morbidities	1.14 (0.87 to 1.48)	
Prior injury		
No	Ref	0.1
Yes	0.82 (0.63 to 1.06)	
Prior disabling condition		
No	Ref	0.7
Yes	1.04 (0.77 to 1.40)	
Pain or discomfort		
None	Ref	0.1
Moderate	1.00 (0.70 to 1.43)	
Extreme	3.46 (0.93 to 12.78)	
Work capacity		
High (≥7)	Ref	0.9

Low (<7)	1.01 (0.48 to 2.11)	
Model 7: Injury-related factors (n=2509)		
Work-related injury		
No	Ref	>0.001
Yes	1.46 (1.21 to 1.78)	
Intent of injury event		
No	Ref	0.07
Yes – assaultive	1.55 (0.96 to 2.50)	
Injury a threat to life		
No	Ref	>0.001
Yes/Maybe	1.94 (1.45 to 2.58)	
Injury a threat of serious disability		
No	Ref	0.9
Yes/Maybe	1.00 (0.82 to 1.21)	
Hospital admission		
No	Ref	
Yes	1.74 (1.42 to 2.13)	>0.001
Access to health services		
No difficulties accessing	Ref	
Difficulties accessing	0.95 (0.70 to 1.29)	0.7

*All dimension-level models were adjusted for age, gender, hospital admission, body region injured, nature of injury & time since injury.

Table 3 presents the overall multidimensional logistic regression model identifying the strongest (as defined by the variable p-value <0.10) predictors of not working 3 months after injury. Several socio-demographic factors were associated with greater odds of not working including: workers with a low personal income; those who gave no income; workers with a blue collar occupation and those reporting financial insecurity. While age was significantly associated with not working as a term, no individual age category was at significantly higher odds of not working compared to the reference of 18-24 year olds. Physical work conditions associated with increased odds of not working included those working in painful/tiring, or standing positions at work. Unlike the bivariate analysis, the association between not working and repetitive hand movements was not significant in the physical work factor model, however it remains in the overall multi-dimensional model as it fits the backwards stepwise elimination criteria (p<0.10). Several work organisational factors were associated with greater odds of not working: workers with temporary/casual employment contracts compared to those with permanent contracts and workers with long-week work schedules compared to those working ≤5 days.

Table 3: Significant independent predictors of not working three months following injury. (n=2250)

Explanatory variable	**Work absent** ***n=609*** **N**	**Adjusted * odds ratio**	**95% CI**	**p-value**
Sociodemographic: Age				
18-24	95	Ref		0.004
25-34	96	0.73	0.50 to 1.07	
35-44	146	1.23	0.85 to 1.78	

45-54	172	1.33	0.92 to 1.91	
55-64	100	1.28	0.86 to 1.91	
Sociodemographic: Gender				
Male	424	Ref		0.5
Female	185	0.93	0.72 to 1.20	
Sociodemographic: Income				
≥ $50,000	140	Ref		<0.001
$30,001-$50,000	208	1.16	0.88 to 1.53	
≤ $30,000	149	1.52	1.09 to 2.12	
Refused to give income	112	2.11	1.49 to 2.98	
Sociodemographic: Financial security				
Secure/Fairly secure	436	Ref		0.006
Fairly insecure/Insecure	173	1.41	1.10 to 1.80	
Sociodemographic: Occupation				
White collar	146	Ref		0.01
Pink collar	120	1.04	0.76 to 1.42	
Blue collar	331	1.52	1.14 to 2.02	
Unclassified	12	0.96	0.46 to 2.01	
Physical work: Painful/tiring body positions				
Never	216	Ref		<0.001
Occasionally/sometimes	168	1.33	1.01 to 1.74	
¼-½ the time	116	2.12	1.54 to 2.92	

¾ of time or greater	109	1.93	1.38 to 2.72	
Physical work: Standing				
never	42	Ref		<0.001
occasionally/sometimes	66	1.92	1.20 to 3.07	
¼-½ the time	91	1.60	1.03 to 2.49	
¾ of time or greater	410	2.25	1.51 to 3.34	
Physical work: Repetitive hand movements				
never	104	Ref		0.03
occasionally/sometimes	71	0.69	0.46 to 1.02	
¼-½ the time	107	0.76	0.53 to 1.09	
¾ of time or greater	327	1.04	0.76 to 1.42	
Work organisation: Employment contract				
Permanent	410	Ref		0.02
Temporary	64	1.89	1.27 to 2.81	
Fixed term	32	1.43	0.87 to 2.33	
Other or no formal contract	12	1.62	0.73 to 3.59	
Self-employed	62	1.10	0.76 to 1.59	
Employer	29	0.82	0.49 to 1.36	
Work organisation: Number of days worked per week				
≤5 days per week	419	Ref		<0.001
6-7 days per week	190	1.54	1.21 to 1.96	
Lifestyle: BMI				

Under/normal weight (≤24)	193	Ref		0.01
Over weight (25-29)	238	1.18	0.92 to 1.51	
Obese (≥30)	178	1.48	1.13 to 1.94	
Lifestyle: Sleep quantity (nights ≥7hrs sleep)				
5-7 nights	475	Ref		0.06
≤ 4 nights	134	0.79	0.61 to 1.01	
Lifestyle: Exercise (days per week)				
5-7 days	392	Ref		<0.001
≤4 days	217	0.67	0.54 to 0.83	
Injury: Hospital admission				
No	369	Ref		<0.001
Yes	240	2.10	1.66 to 2.64	
Injury: Self-perceived threat to life				
No	505	Ref		<0.001
Yes/Maybe	104	1.90	1.38 to 2.62	

*adjusted for body region injured, nature of injury, time since injury

While the overall Body Mass Index term did not have a significant association with not working in the overall model, obesity was significantly associated with increased odds of not working compared to the reference of normal Body Mass Index. The lifestyle factors of lower pre-injury exercise frequency was associated with reduced odds of not working. The other lifestyle factor pre-injury sleep was not associated with working status but remains in the model as it fits the model criteria. Injury-related factors associated with increased odds of not working that remained in the overall multi-dimensional

model were: those workers who perceived their injury was a threat to their life and those who were admitted to hospital following their injury. None of the psychosocial or health factor variables examined in this study remained in the overall multidimensional model. Diagnostic testing of the overall model indicated goodness of fit was acceptable (χ^2=2279, p=0.13) and the model had good accuracy in correctly discriminating if a worker was absent from work (area under curve=0.76).[25] The pseudo R^2 was 0.1533.

DISCUSSION

This paper presents evidence regarding pre-injury predictors of not working three months after injury. The injuries sustained by this cohort were sufficient enough to potentially warrant at least one week of entitlement compensation. The multivariable multidimensional model confirmed a set of important pre-injury predictors of not working three months following injury. Specifically, our analysis confirmed previous findings that certain socio-demographic, work and injury factors predict work status. This study also broadened the focus to examine dimensions rarely examined previously and found work organisation and lifestyle factors were also important predictors of work status. Psychosocial factors were suggested in prior studies to be an important predictor of working after injury [18 17], however, of the pre-injury psychosocial variables examined in this study, none were found to be important in predicting work status. Our study simultaneously controlled for a broader range of determinants than have previously been investigated by researchers examining the association between psychosocial variables and work status, and this may offer one explanation why there was a lack of association between psychosocial factors and work status in our study. Health-related factors, rarely examined previously, were not found to be important predictors of work status. Our findings further confirm the need for future studies to examine a broader range of determinants and assess the relative importance of these for work disability.[18]

Our findings are consistent with many studies that demonstrate a relationship between work status and economic security,[16-18] with low income workers most likely to be absent from work compared with high income workers. Additionally those who did not provide income for the income variable were more likely to be absent from work. Further descriptive analysis, not presented here, found these workers were most likely to be on employment contracts that result in fluctuating work patterns, suggesting these workers may find it difficult to provide an estimate of their annual personal income. Financial insecurity, a marker of future economic security, was associated with not working. While financial insecurity is a predictor of health outcomes,[26] there has been little examination of financial insecurity in relation to work status following injury. Financial insecurity is thought to influence mental health outcomes through anxiety generated by feelings of future economic insecurity. [26] This potential pathway needs further examination with regard to work status.

Occupational factors were important predictors of not working in our study. Previous studies using various occupational classification schemes or categorisations across have reported mixed findings regarding occupation.[17 18] In our study, a blue collar occupation had a higher likelihood of not working. Our findings are consistent with previous cohort studies reporting blue collar workers as less likely to have returned to work following injury adding further strength to the evidence for a causal relationship.[17 18] Physical work tasks involving painful/tiring body positions or standing were at increased likelihood of not working. Exposure to physical work tasks or blue collar work in general are commonly associated with an increased risk of not working following injury.[17 18] However, specific ergonomic hazards are rarely examined with regard to work status and our study identifies potentially modifiable workplace ergonomic hazard exposures that are associated with not working.

Aspects of work organisation are rarely examined in injury populations and our study found two important groups of workers at increased likelihood of not working: temporary and long-week workers. Temporary employees have the poorest social and employment protections, working conditions and higher risk of unemployment when compared with the permanent workforce.[27] Our finding that workers with temporary employment were more likely to be not working compared to those in other types of employment possibly reflects difficulties for employees in: retaining their jobs following injury; negotiating a modified return to work; or in obtaining new employment in a tight labour market. Studies examining long-term sickness absence report lower rates of absence for temporary employees, suggesting poor social protections are a key determinant of sickness absence-taking behaviour.[28 29] Further examination of potential social and material pathways through which temporary employment can impinge upon the return to work process is warranted. Long-week work schedules also predicted not working. While long-week work schedules have not specifically been found to be associated with not working that we are aware of, other non-standard work schedules, such as long-day work schedules, have been reported to disrupt a full return to work following workplace injury.[30]

Our study found obese workers were more likely to not be working three months following injury. Increasingly studies are showing relationships between obesity, and illness-related work disability.[31-33] However, few studies have investigated the impact of pre-injury obesity on work status following injury.[31] Obesity is often associated with a long list of chronic health conditions and while this multivariable analysis examined the presence of co-morbidities, more specific examination is needed to explain our findings.

Contradictory to expectations those who had higher levels of exercise prior to injury were less likely to have returned to work in our study. Our findings differ to those of a study demonstrating those with moderate fitness prior to injury are more likely to have returned to work three months following a whiplash injury.[34] Those workers used to getting regular exercise prior to their injury may have experienced a substantial change in their exercise patterns as a consequence of their injury. Conceivably, they may have to cope with fewer exercise opportunities – with possible impacts on their ability to work. This may not be occurring to the same extent among workers already used to irregular exercise before injury.

Two injury-related factors were strongly associated with increased odds of not working: workers who perceived that their injury was a threat to their life and those whose injury resulted in hospital admission. While it might be reasonable to explain these observations by considering injury severity, examination of hospital admission and threat to life within our cohort found the two variables were measuring independent effects. Perceived threat to life is strongly associated with post-traumatic stress disorder,[35] and post-traumatic stress disorder has been found to be strongly associated with failure to work following injury [36 37]. Further work to examine potential pathways of effect is required. Our finding that hospital admission predicts not working three months following injury corroborates previous findings in the few studies to include non-hospitalised injuries that report that intensive care admission and length of hospital stay predicts work status.[9]

The findings from our multidimensional analysis of a wide spectrum of injuries indicate interventions to improve opportunities for working in the short-term following injury need to target a broad range factors. As we have found some previously-unreported findings, these will need to be confirmed with additional research. However, our findings indicate some self-reported pre-injury measures of socio-

demographic, workplace and lifestyle-related factors could be used to identify individuals with increased odds of not working three months after injury. This paper identifies a number of pre-injury factors which are potentially amenable to primary intervention, such as workplace hazard exposures, obesity and physical exercise. For example, workplace physical activity interventions have been shown to improve worksite outcomes, such as sick leave.[38] If confirmed, our findings would suggest that primary workforce interventions focusing on lifestyle-related factors may contribute to a reduction in rates of not working three months following injury, as well as contributing to maintaining a healthy and productive workforce.

The strengths of the study include the collection of pre-injury information, large sample size, inclusion of traditionally-conceived 'less severe' non-hospitalised injuries, and the collection and combined multivariable examination of a wide range of potential determinants of work status. Consequently we have found a number of important and previously unreported associations generating new hypotheses for further examination. There are a few limitations to our study. This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently recall bias might occur. However, workers were specifically directed to consider their pre-injury exposures and few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. The exception to this are the psychosocial factors that may be subject to recall bias. If so, this could have contributed to a lack of relationship between psychosocial factors and not working following injury. Recall of the baseline pre-injury work status at the 3 month interview may be subject to recall bias. However, verification of employment status with ACC claims records indicates the likelihood of this is low with 1% of participants having a non-concordant employment status between the self-reported and claims record data. The use of single item

measures for psychological constructs, such as job satisfaction and optimism, is a potential limitation to this study. However, parsimonious measures have been found to demonstrate good reliability and validity. Furthermore, we were concerned to minimise participant interview burden (the interview took 60 minutes to complete). A further limitation is the design of New Zealand's no-fault ACC compensation system meaning the findings of this study are potentially not generalisable beyond no-fault compensation systems. However, the no-fault nature of ACC is also a strength of our study. In other injury-compensation systems, where people are required to litigate to gain access to compensation following injury, incentives may exist such that people would be ill-advised to return to work prior to their legal case for compensation coming before the court. Recruiting participants, via the universal no-fault ACC scheme does not allow us to examine work status outcome in relation to whether or not people were granted access to ACC. There may be injured New Zealanders, not included in our study, who did not access medical support from a health professional for their injury (a necessary requirement to become registered with ACC), or, who were not referred to ACC by a health professional. There is moderate evidence that the receipt and extent of compensation has a negative effect upon returning to work following injury in healthcare systems where only certain causes of injury receive compensation, such as those caused by a motor vehicle traffic crash or while at work.[4 39] However, it is a strength of the study that the universal nature of this scheme allows us to examine predictors of work status in the short-term in a broader population context of injury and work than previously examined.

In conclusion, this study indicates a number of pre-injury socio-demographic, occupational and lifestyle factors, as well as injury factors, were associated with not working three months after injury in a sample of New Zealand workers. This study confirms that the predictors of work status following injury

are multidimensional and that future studies need to examine a broader range of determinants for work disability. If these findings are confirmed, intervention strategies aimed at identifying workers at increased risk of not working and improving work status in the short-term following injury should address multiple dimensions of the worker and workplace.

Article Summary

Article Focus

- Previous examinations of predictors of work status following injury have focused primarily on hospitalised patients and a limited range of risk factors; this study examines multidimensional predictors of work status three months following hospitalised and non-hospitalised injuries.

Key Message

- While previous findings on socio-demographic and work factors were confirmed, a number of rarely-examined variables were associated with increased odds of not working including: obesity, temporary employment, long-day work schedules and financial insecurity.
- Contrary to expectations, workers who were infrequent exercisers prior to injury were more likely to be working after injury.
- This study identified a range of potential predictors of not working that, if causal, help identify workers at increased risk of not working three months after injury. If confirmed, intervention strategies should target these groups to reduce short-term work disability.

Strengths and Limitations

- The strengths of the study include the collection of pre-injury information, large sample size, inclusion of non-hospitalised and hospitalised injuries, and the collection and combined

multivariable examination of a wide range of potential determinants of work status. Consequently this study has generated new hypotheses for further examination.

- This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently recall bias might occur. However, few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. The design of New Zealand's universal no-fault injury compensation system may limit the generalisability of study findings beyond similar systems. However, the universal nature of the New Zealand scheme allows the examination of predictors of work status in a broader population context of injury and work than previously examined.

ACKNOWLEDGEMENTS

We are most grateful to the study participants for sharing their information with us. We thank Professor John Langley, Associate Professor Colin Cryer and Natalie Hardaker for helpful comments on an earlier draft of this paper.

FUNDING

This study is funded by the Health Research Council of New Zealand (2007-2013), and was co-funded by the Accident Compensation Corporation, New Zealand (2007-2010) (ID 10/052). Dr Rebbecca Lilley was supported by an Accident Compensation Corporation Early Career Post Doctoral Award (2007-2010) (ID 07/049). The views and conclusions in this paper are the authors' and may not reflect those of the funders.

The funders of this project provided funding for salary and working expenses and had no input in the study design, data collection, data analysis or interpretation with the sole exception of the Accident Compensation Corporation who provided the initial sampling list.

COMPETING INTERESTS

None declared

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Factors predicting work status three months after injury: results from the Prospective Outcome of Injury Study

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Counts: main text 3571~~234~~ words; abstract 2244~~6~~ words; figures 0; tables 3; appendices 1

Key words: Wounds and injuries; work; rehabilitation, vocational; cohort study.

ABSTRACT

Objective: Few studies examine predictors of work status following injury beyond injuries presenting to a hospital or emergency department. This paper examines the combined influences of socio-demographic, occupational, injury, and pre-existing health and lifestyle factors as predictors of work status three months after hospitalised and non-hospitalised injury in a cohort of injured New Zealand workers.

Design: Prospective cohort study

Setting: The Prospective Outcomes of Injury Study, New Zealand.

Participants: 2626 workforce active participants were identified from the Prospective Outcomes of Injury Study; 11 participants with missing outcome responses were excluded.

Primary and secondary outcome measures: The primary outcome of interest was 'not working' at the time of interview.

~~**Methods:** Workforce active participants (n=2626) were identified from the Prospective Outcomes of Injury Study, a cohort study of injured people registered with New Zealand's national no-fault insurance agency. Seven dimensions were considered: six pre-injury dimensions (socio-demographic, physical work, psychosocial, work organisation, lifestyle, health) plus an injury-related dimension. The outcome of interest was 'not working' at the time of interview. Multivariable logistic regression models were built for each of the seven dimensions and an overall multi-dimensional model.~~

Results: 720 (27%) reported 'not working' three months after injury. Multidimensional modelling found the most important pre-injury predictors of not working following injury were: low or unknown income, financial insecurity, physical work tasks, temporary employment, long-week schedules, obesity, perceived threat to life and hospital admission. Contrary to expectations, workers reporting

less frequent exercise pre-injury had lower odds of work absence. Pre-injury psychosocial and health factors were not associated with not working.

Conclusion: Certain pre-injury socio-demographic, physical work, work organisation, lifestyle and injury-related factors were associated with not working three months after injury. If these findings are confirmed, intervention strategies aimed at improving return to work should address multiple dimensions of both the worker and workplace.

BACKGROUND

A timely and sustainable return to work is a crucial rehabilitation outcome for workers following injury, as prolonged work absences result in significant personal and societal costs.[1 2] Many studies investigating factors associated with work status following injury are restricted to particular injury types or body regions.[3-6] Others have primarily focused on injuries resulting in a hospital emergency department visit or admission.[3 4 7-13] Few studies have examined work status following injury outside a hospital recruitment setting.[14 15] However when considering the total burden of injury, many seemingly "minor" injuries that do not result in hospitalisation, such as soft tissue injuries, can result in substantial time away from the workplace for rehabilitation and recovery.

Researchers investigating return to work following injury have utilised different times to follow-up and different risk factors, outcome measures, and sample populations. However, despite these differences socio-demographic, clinical and occupational factors ~~have tended to be been found to determine~~ are commonly associated with work status following injury.[16-18] The need for broader examination of potential determinants of work status using a bio-psychosocial perspective in the trauma population was recently highlighted.[18] For example, pre-injury health and lifestyle factors associated with return to work following lower back pain[19] have rarely been examined and there has been limited examination of potential psychosocial risk factors following injury.[18] In New Zealand, research appears to have been limited to examining time on compensation in workers with chronic back pain.[20]

New Zealand's universal no-fault compensation scheme (administered by the Accident Compensation Corporation – ACC) provides the opportunity to examine determinants of work status for workers with

compensated injuries sustained in a broader context. The aim of this paper is to examine the combined influences of socio-demographic, occupational, pre-existing health and lifestyle factors and injury, as predictors of work status three months following injury in a cohort of injured New Zealand workers.

METHODS

Study setting

The Prospective Outcomes of Injury Study (POIS) cohort was recruited via New Zealand's no-fault, non-tortious ~~Accident Compensation Corporation~~ACC scheme. People were not eligible to participate if their injury was the result of self-hamr , or if their injury resulted in their being placed on ACC's sensitive claims register (e.g. sexual assault). POIS participants include those who consulted with a primary or secondary health care professional for an injury, and then consequently, were placed on ~~the Accident Compensation Corporation's~~ ACC's entitlement claims register. Each year there are approximately 1.75 million injuries claims in New Zealand.[21] Of these, 7% are placed on an entitlement claimants register because they are likely to require more than simple medical treatment. ~~This register is comprised of people with an injury likely to require more than acute treatment only.~~ For example, people likely to require a week or more off work or home support and/or rehabilitation are placed on this register. POIS participant's injuries were variously sustained in recreational, road, home, public, and workplace settings. Injured people living in one of five regions of New Zealand aged 18-65 years, who had sustained an injury between June 2007 and May 2009, identified via the ~~Accident Compensation Corporation~~ACC scheme entitlement claims register were eligible for inclusion. The recruitment process and resulting cohort has been described in detail elsewhere.[22 23]

Data collection and explanatory variables

Between December 2007 to August 2009, 2856 participants were recruited.[23] Of these, 2626 (92%) responded they were working for pay ('workforce active') prior to their injury, and they are the cohort presented in this paper. Of the 2626 POIS participants who were workforce-active pre-injury, 11 were missing responses to the work-status question at the 3 month post injury survey and were excluded from this investigation. Of the remaining 2615 workers, 720 (27%) reported not working at the time of interview (median time to interview was 3.4 months after injury; interquartile range: 2.5 to 4.1 months). Self-reported data, including pre-injury characteristics were mainly collected by telephone interview (89%) and postal survey (11%), on average, three months following injury.

All explanatory variables are pre-injury measures retrospectively collected at the 3 month interview, with the exception of the injury-related variables which relate to the injury event itself. Each explanatory variable was selected on the basis of an a priori hypothesis of a relationship with not working following injury, and/or having been identified in previous studies.[18 19] These measures, assessed at interview, have been grouped into seven dimensions:

1) socio-demographic (age, gender, income, highest qualification, occupation, relationship status, living arrangements, material standard of living, adequacy of household income, financial security);

2) physical work (repetitive hand movements, heavy lifting, physical exertion, standing, or working in painful/tiring body positions);

3) psychosocial (job strain, job support, job security, job satisfaction, optimism, self-efficacy, prior depressive episode);

4) work organisational (hours of work, number of days worked per week, employment contract, multiple job holding) ;

5) lifestyle (alcohol consumption, current smoking status, Body Mass Index (BMI), exercise, sleep quantity);

6) health (overall self-assessment for health, co-morbidities, pain or discomfort, prior injury, prior disabling condition, work capacity);

7) injury-related (work-related injury, intent of injury, hospital admission, injury a threat to life, injury a threat of serious disability, access to health services).

For more detailed information about the explanatory variables, see the online appendix 1.

Outcome

Work status was assessed using a single item "*Are you back at work following your injury?*" (yes, no). A participant was considered to be working at time of interview, regardless of whether they were working with their pre-injury employer, a new employer or working under modified working conditions, such as reduced work hours. The majority (82%) of the cohort have had a week, or more, off work and received earnings-related compensation from the ACC~~Accident Compensation Corporation~~ scheme. The remainder may have had less time off work or been ineligible for earnings-related compensation. Not being in work at the time of interview is referred to in this paper as not working.

Data analysis

Frequency tables, summary statistics and binary logistic regression analyses were used to examine the relationship between not working and pre-injury characteristics and injury-related factors.

Initially dimensional models were built using multivariable logistic regression analyses of all study variables within each of the seven dimensions simultaneously entered into individual models. Age, gender, hospital admission, body region injured, and nature of injury were included in all models as potential confounders. Based upon participants' descriptions body region injured (lower extremities; upper extremities; head and neck; spine and back; torso; and multiple body regions) and nature of injury (fractures; sprains and strains; concussion; open wound/amputations; contusion/superficial; other single injury type; and multiple injury types) were assigned using a modified version of the Barell Matrix.[24] Time since injury was included as a continuous variable into all analyses to account for the range in the timing of interviews after the injury event.

An overall multidimensional model was built by entering explanatory variables from each of the seven dimension models showing an association of $p<0.20$ with not working as independent variables. Backward stepwise elimination (criteria $p<0.10$) was used to select the final variables for inclusion. Post-hoc testing of model using the Hosmer and Lemeshow goodness of fit test and area under the curve was undertaken to assess model fit. Analyses were performed using STATA statistical package 11.1.

Ethics

Ethical approval for this study was obtained from the New Zealand Multi-Region Ethics Committee. Informed consent was obtained from all participants.

RESULTS

~~Of the 2626 POIS participants who were workforce-active pre-injury, 11 were missing responses to the work-status question at the 3 month post injury survey and were excluded from this investigation. Of the remaining 2615 workers, 720 (27%) reported not working at the time of interview (median time to interview was 3.4 months after injury; interquartile range: 2.5 to 4.1 months).~~

The mean age of participants was 41 years (SD 13 years). The majority of the cohort are male (63%), had post-secondary qualifications (60%), and were employees (85%)(see online table 1). The median annual personal income was $45,000. Annual personal income was not provided by 16% of participants. The predominant injury type was multiple injury types (39%), followed by sprains and strains (26%) and fractures (17%). The lower (37%) and upper extremities (28%) were the most frequent body regions injured, followed by multiple injury regions (18%). Thirty percent of the cohort reported hospital admission, while a further 36% reported attending an Emergency Department (without hospital admission).

Table 2 shows the dimension-specific multivariable analyses in relation to not working three months after injury. The following pre-injury variables had p-values <0.20 in the dimension-specific logistic regression modelling:

sociodemographics (age, gender, highest qualification, income, occupation, relationship status, adequacy of household income, financial security);

physical work (repetitive hand movements, heavy lifting, painful/tiring body positions, standing);

psychosocial (job strain, job support, job security, prior depressive episode);

work organisational (hours of work, number of days worked per week, employment contract);

lifestyle (current smoking status, BMI, exercise, sleep quantity);

health (co-morbidities, prior injury, pain or discomfort); and

injury-related (work-related injury, injury a threat to life, intent of injury, hospital admission).

In order to identify the strongest predictors of not working across all dimensions, all these variables were entered in a multivariable logistic regression analysis.

Table 2: Dimension level multivariable analyses for not working three months after injury.

Dimension Model **Variable**	**Adjusted* odds ratio (95% CI)**	**p-value**
Model 1: Pre-injury socio-demographic factors (n=2368)		
Age		
18-24	Ref	0.05
25-34	0.72 (0.49 to 1.05)	
35-44	1.12 (0.77 to 1.63)	
45-54	1.07 (0.73 to 1.57)	
55-64	0.94 (0.62 to 1.42)	
Gender		
Male	Ref	0.2
Female	0.87 (0.69 to 1.11)	
Highest qualification		
Post secondary qualifications	Ref	0.01
Secondary qualifications	0.98 (0.77 to 1.24)	
No formal qualifications	1.44 (1.09 to 1.89)	

Income		
≥$50,001	Ref	<0.001
$30,001-$50,000	1.24 (0.95 to 1.61)	
≤ $30,000	1.81 (1.33 to 2.48)	
No income given	2.24 (1.63 to 3.07)	
Occupation		
White collar	Ref	<0.001
Pink collar	1.26 (0.94 to 1.68)	
Blue collar	2.15 (1.65 to 2.81)	
Unclassified	1.14 (0.59 to 2.17)	
Relationship Status		
Married/De Facto/Civil Union	Ref	0.1
Never married	1.17 (0.84 to 1.62)	
Separated/Divorced	1.34 (0.92 to 1.94)	
Widowed	2.19 (0.94 to 5.12)	
Living arrangements		
Living alone	Ref	0.3
Living with familial other	1.31 (0.87 to 1.96)	
Living with non-familial other	1.37 (0.84 to 2.22)	
Adequacy of household income		
Sufficient	Ref	0.1
Insufficient	1.17 (0.94 to 1.47)	

Material standard of living		
High/Fairly high	Ref	0.4
Medium	1.08 (0.87 to 1.35)	
Fairly low/Low	0.82 (0.49 to 1.35)	
Financial security		
Secure/Fairly secure	Ref	<0.001
Fairly insecure/Insecure	1.55 (1.22 to 1.96)	
Model 2: Pre-injury physical work factors (n=2509)		
Repetitive hand movements		
Never	Ref	0.09
Occasionally/sometimes	0.78 (0.55 to 1.13)	
¼ to ½ the time	0.77 (0.55 to 1.06)	
¾ of time or greater	1.03 (0.78 to 1.36)	
Heavy lifting		
Never	Ref	0.05
Occasionally/sometimes	1.29 (0.98 to 1.72)	
¼ to ½ the time	1.37 (0.99 to 1.89)	
¾ of time or greater	1.66 (1.15 to 2.38)	
Painful/tiring body positions		
Never	Ref	0.001
Occasionally/sometimes	1.17 (0.91 to 1.51)	
¼ to ½ the time	1.96 (1.44 to 2.65)	

¾ of time or greater	1.61 (1.16 to 2.24)	
Standing		
Never	Ref	>0.001
Occasionally/sometimes	1.65 (1.08 to 2.54)	
¼ to ½ the time	1.32 (0.87 to 1.99)	
¾ of time or greater	2.03 (1.38 to 2.96)	
Physical exertion		
Never	Ref	0.6
Occasionally/sometimes	1.18 (0.88 to 1.59)	
¼ to ½ the time	1.08 (0.78 to 1.49)	
¾ of time or greater	1.19 (0.86 to 1.65)	
Model 3: Pre-injury psychosocial factors (n=2362)		
Job strain		
Low strain	Ref	>0.001
Active	0.88 (0.66 to 1.17)	
Passive	1.37 (1.02 to 1.83)	
High strain	1.52 (1.13 to 2.02)	
Job support		
Quartile 1- High	Ref	0.03
Quartile 2	0.65 (0.46 to 0.94)	
Quartile 3	0.73 (0.57 to 0.94)	
Quartile 4 – Low	0.80 (0.61 to 1.04)	

Job security		
Very secure	Ref	0.03
Secure	1.27 (1.02 to 1.59)	
Insecure/very insecure	1.46 (1.02 to 2.10)	
Job satisfaction		
Completely/mostly satisfied	Ref	0.4
Neither satisfied nor dissatisfied	0.85 (0.61 to 1.20)	
Mostly/completely dissatisfied	0.80 (0.51 to 1.26)	
Self-efficacy		
Good	Ref	0.2
Poor	0.80 (0.56 to 1.14)	
Optimism		
Yes	Ref	0.5
No	1.09 (0.81 to 1.47)	
Prior depressive episode		
No	Ref	0.03
Yes	1.27 (1.02 to 1.59)	
Model 4: Pre-injury work organisational factors (n=2518)		
Hours of work		
≤ 30 hrs	Ref	0.004
31-45 hrs	0.84 (0.63 to 1.14)	
45-65 hrs	0.86 (0.61 to 1.22)	

≥ 66 hrs	1.32 (0.72 to 2.44)	
Number of days worked per week		
≤ 5 days	Ref	>0.001
6-7 days	1.68 (1.31 to 2.15)	
Employment contract		
Employee - permanent	Ref	>0.001
Employee - temporary/casual	2.25 (1.58 to 3.20)	
Employee - fixed term	1.51 (0.98 to 2.35)	
Employee - other contract types	1.50 (0.76 to 2.98)	
Self-employed	1.20 (0.87 to 1.66)	
Employer	0.70 (0.44 to 1.12)	
Multiple job holding		
Yes	Ref	0.8
No	1.04 (0.74 to 1.45)	
Model 5: Pre-injury lifestyle factors (n=2445)		
Alcohol consumption		
Low	Ref	0.6
High	0.95 (0.77 to 1.18)	
Current smoking status		
No	Ref	0.009
Yes	0.76 (0.62 to 0.93)	
Body Mass Index		

≤24	Ref	>0.001
25-29	1.24 (0.99 to 1.56)	
≥30	1.61 (1.26 to 2.05)	
Exercise (days per week)		
5-7 days	Ref	>0.001
≤ 4 days	0.63 (0.52 to 0.76)	
Sleep quantity (per week)		
5-7 nights obtaining ≥7hrs sleep	Ref	0.1
≤ 4 nights obtaining ≥7hrs sleep	0.85 (0.68 to 1.07)	
Model 6: Pre-injury health factors (n=2426)		
Overall self-assessment for health		
Excellent/Very Good	Ref	0.4
Good/Fair/Poor	0.91 (0.73 to 1.13)	
Co-morbidities		
No co-morbidities	Ref	0.06
1 co-morbidities	0.82 (0.66 to 1.04)	
2 or more co-morbidities	1.14 (0.87 to 1.48)	
Prior injury		
No	Ref	0.1
Yes	0.82 (0.63 to 1.06)	
Prior disabling condition		
No	Ref	0.7

Yes	1.04 (0.77 to 1.40)	
Pain or discomfort		
None	Ref	0.1
Moderate	1.00 (0.70 to 1.43)	
Extreme	3.46 (0.93 to 12.78)	
Work capacity		
High (≥7)	Ref	0.9
Low (<7)	1.01 (0.48 to 2.11)	
Model 7: Injury-related factors (n=2509)		
Work-related injury		
No	Ref	>0.001
Yes	1.46 (1.21 to 1.78)	
Intent of injury event		
No	Ref	0.07
Yes – assaultive	1.55 (0.96 to 2.50)	
Injury a threat to life		
No	Ref	>0.001
Yes/Maybe	1.94 (1.45 to 2.58)	
Injury a threat of serious disability		
No	Ref	0.9
Yes/Maybe	1.00 (0.82 to 1.21)	
Hospital admission		

No	Ref	
Yes	1.74 (1.42 to 2.13)	>0.001
Access to health services		
No difficulties accessing	Ref	
Difficulties accessing	0.95 (0.70 to 1.29)	0.7

*All dimension-level models were adjusted for age, gender, hospital admission, body region injured, nature of injury & time since injury.

Table 3 presents the overall multidimensional logistic regression model identifying the strongest (as defined by the variable p-value <0.10) predictors of not working 3 months after injury. Several socio-demographic factors were associated with greater odds of not working including: workers with a low personal income; those who gave no income; workers with a blue collar occupation and those reporting financial insecurity. While age was significantly associated with not working as a term, no individual age category was at significantly higher odds of not working compared to the reference of 18-24 year olds. Physical work conditions associated with increased odds of not working included those working in painful/tiring, or standing positions at work. Unlike the bivariate analysis, the association between not working and repetitive hand movements was not significant in the physical work factor model, however it remains in the overall multi-dimensional model as it fits the backwards stepwise elimination criteria (p<0.10). Several work organisational factors were associated with greater odds of not working: workers with temporary/casual employment contracts compared to those with permanent contracts and workers with long-week work schedules compared to those working ≤5 days.

Table 3: Significant independent predictors of not working three months following injury. (n=2250)

Explanatory variable	Work absent *n=609* N	Adjusted * odds ratio	95% CI	p-value
Sociodemographic: Age				
18-24	95	Ref		0.004
25-34	96	0.73	0.50 to 1.07	
35-44	146	1.23	0.85 to 1.78	
45-54	172	1.33	0.92 to 1.91	
55-64	100	1.28	0.86 to 1.91	
Sociodemographic: Gender				
Male	424	Ref		0.5
Female	185	0.93	0.72 to 1.20	
Sociodemographic: Income				
≥ $50,000	140	Ref		<0.001
$30,001-$50,000	208	1.16	0.88 to 1.53	
≤ $30,000	149	1.52	1.09 to 2.12	
Refused to give income	112	2.11	1.49 to 2.98	
Sociodemographic: Financial security				
Secure/Fairly secure	436	Ref		0.006
Fairly insecure/Insecure	173	1.41	1.10 to 1.80	
Sociodemographic: Occupation				
White collar	146	Ref		0.01

Pink collar	120	1.04	0.76 to 1.42	
Blue collar	331	1.52	1.14 to 2.02	
Unclassified	12	0.96	0.46 to 2.01	
Physical work: Painful/tiring body positions				
Never	216	Ref		<0.001
Occasionally/sometimes	168	1.33	1.01 to 1.74	
¼-½ the time	116	2.12	1.54 to 2.92	
¾ of time or greater	109	1.93	1.38 to 2.72	
Physical work: Standing				
never	42	Ref		<0.001
occasionally/sometimes	66	1.92	1.20 to 3.07	
¼-½ the time	91	1.60	1.03 to 2.49	
¾ of time or greater	410	2.25	1.51 to 3.34	
Physical work: Repetitive hand movements				
never	104	Ref		0.03
occasionally/sometimes	71	0.69	0.46 to 1.02	
¼-½ the time	107	0.76	0.53 to 1.09	
¾ of time or greater	327	1.04	0.76 to 1.42	
Work organisation: Employment contract				
Permanent	410	Ref		0.02
Temporary	64	1.89	1.27 to 2.81	
Fixed term	32	1.43	0.87 to 2.33	

Other or no formal contract	12	1.62	0.73 to 3.59	
Self-employed	62	1.10	0.76 to 1.59	
Employer	29	0.82	0.49 to 1.36	
Work organisation: Number of days worked per week				
≤5 days per week	419	Ref		<0.001
6-7 days per week	190	1.54	1.21 to 1.96	
Lifestyle: BMI				
Under/normal weight (≤24)	193	Ref		0.01
Over weight (25-29)	238	1.18	0.92 to 1.51	
Obese (≥30)	178	1.48	1.13 to 1.94	
Lifestyle: Sleep quantity (nights ≥7hrs sleep)				
5-7 nights	475	Ref		0.06
≤ 4 nights	134	0.79	0.61 to 1.01	
Lifestyle: Exercise (days per week)				
5-7 days	392	Ref		<0.001
≤4 days	217	0.67	0.54 to 0.83	
Injury: Hospital admission				
No	369	Ref		<0.001
Yes	240	2.10	1.66 to 2.64	
Injury: Self-perceived threat to life				
No	505	Ref		<0.001
Yes/Maybe	104	1.90	1.38 to 2.62	

*adjusted for body region injured, nature of injury, time since injury

While the overall Body Mass Index term did not have a significant association with not working in the overall model, obesity was significantly associated with increased odds of not working compared to the reference of normal Body Mass Index. The lifestyle factors of lower pre-injury exercise frequency was associated with reduced odds of not working. The other lifestyle factor pre-injury sleep was not associated with working status but remains in the model as it fits the model criteria. Injury-related factors associated with increased odds of not working that remained in the overall multi-dimensional model were: those workers who perceived their injury was a threat to their life and those who were admitted to hospital following their injury. None of the psychosocial or health factor variables examined in this study remained in the overall multidimensional model. Diagnostic testing of the overall model indicated goodness of fit was acceptable (χ^2=2279, p=0.13) and the model had good accuracy in correctly discriminating if a worker was absent from work (area under curve=0.76).[25] The pseudo R^2 was 0.1533.

DISCUSSION

This paper presents evidence regarding pre-injury predictors of not working three months after injury. The injuries sustained by this cohort were sufficient enough to potentially warrant at least one week of entitlement compensation. The multivariable multidimensional model confirmed a set of important pre-injury predictors of not working three months following injury. Specifically, our analysis confirmed previous findings that certain socio-demographic, work and injury factors predict work status. This study also broadened the focus to examine dimensions rarely examined previously and found work organisation and lifestyle factors were also important predictors of work status. Psychosocial factors were suggested in prior studies to be an important predictor of working after injury [18 17], however, of

the pre-injury psychosocial variables examined in this study, none were found to be important in predicting work status. Our study simultaneously controlled for a broader range of determinants than have previously been investigated by researchers examining the association between psychosocial variables and work status, and this may offer one explanation why there was a lack of association between psychosocial factors and work status in our study. Health-related factors, rarely examined previously, were not found to be important predictors of work status. Our findings further confirm the need for future studies to examine a broader range of determinants and assess the relative importance of these for work disability.[18]

Our findings are consistent with many studies that demonstrate a relationship between work status and economic security,[16-18] with low income workers most likely to be absent from work compared with high income workers. Additionally those who did not provide income for the income variable were more likely to be absent from work. Further descriptive analysis, not presented here, found these workers were most likely to be on employment contracts that result in fluctuating work patterns, suggesting these workers may find it difficult to provide an estimate of their annual personal income. Financial insecurity, a marker of future economic security, was associated with not working. While financial insecurity is a predictor of health outcomes,[26] there has been little examination of financial insecurity in relation to work status following injury. Financial insecurity is thought to influence mental health outcomes through anxiety generated by feelings of future economic insecurity. [26] This potential pathway needs further examination with regard to work status.

Occupational factors were important predictors of not working in our study. Previous studies using various occupational classification schemes or categorisations across have reported mixed findings regarding occupation.[17 18] In our study, a blue collar occupation had a higher likelihood of not working.

Our findings are consistent with previous cohort studies reporting blue collar workers as less likely to have returned to work following injury adding further strength to the evidence for a causal relationship.[17 18] Physical work tasks involving painful/tiring body positions or standing were at increased likelihood of not working. Exposure to physical work tasks or blue collar work in general are commonly associated with an increased risk of not working following injury.[17 18] However, specific ergonomic hazards are rarely examined with regard to work status and our study identifies potentially modifiable workplace ergonomic hazard exposures that are associated with not working.

Aspects of work organisation are rarely examined in injury populations and our study found two important groups of workers at increased likelihood of not working: temporary and long-week workers. Temporary employees have the poorest social and employment protections, working conditions and higher risk of unemployment when compared with the permanent workforce.[27] Our finding that workers with temporary employment were more likely to be not working compared to those in other types of employment possibly reflects difficulties for employees in: retaining their jobs following injury; negotiating a modified return to work; or in obtaining new employment in a tight labour market. Studies examining long-term sickness absence report lower rates of absence for temporary employees, suggesting poor social protections are a key determinant of sickness absence-taking behaviour.[28 29] Further examination of potential social and material pathways through which temporary employment can impinge upon the return to work process is warranted. Long-week work schedules also predicted not working. While long-week work schedules have not specifically been found to be associated with not working that we are aware of, other non-standard work schedules, such as long-day work schedules, have been reported to disrupt a full return to work following workplace injury.[30]

Our study found obese workers were more likely to not be working three months following injury. Increasingly studies are showing relationships between obesity, and illness-related work disability.[31-33] However, few studies have investigated the impact of pre-injury obesity on work status following injury.[31] Obesity is often associated with a long list of chronic health conditions and while this multivariable analysis examined the presence of co-morbidities, more specific examination is needed to explain our findings.

Contradictory to expectations those who had higher levels of exercise prior to injury were less likely to have returned to work in our study. Our findings differ to those of a study demonstrating those with moderate fitness prior to injury are more likely to have returned to work three months following a whiplash injury.[34] Those workers used to getting regular exercise prior to their injury may have experienced a substantial change in their exercise patterns as a consequence of their injury. Conceivably, they may have to cope with fewer exercise opportunities – with possible impacts on their ability to work. This may not be occurring to the same extent among workers already used to irregular exercise before injury.

Two injury-related factors were strongly associated with increased odds of not working: workers who perceived that their injury was a threat to their life and those whose injury resulted in hospital admission. While it might be reasonable to explain these observations by considering injury severity, examination of hospital admission and threat to life within our cohort found the two variables were measuring independent effects. Perceived threat to life is strongly associated with post-traumatic stress disorder,[35] and post-traumatic stress disorder has been found to be strongly associated with failure to work following injury [36 37]. Further work to examine potential pathways of effect is required.

Our finding that hospital admission predicts not working three months following injury corroborates previous findings in the few studies to include non-hospitalised injuries that report that intensive care admission and length of hospital stay predicts work status.[9]

The findings from our multidimensional analysis of a wide spectrum of injuries indicate interventions to improve opportunities for working in the short-term following injury need to target a broad range factors. As we have found some previously-unreported findings, these will need to be confirmed with additional research. However, our findings indicate some self-reported pre-injury measures of socio-demographic, workplace and lifestyle-related factors could be used to identify individuals with increased odds of not working three months after injury. This paper identifies a number of pre-injury factors which are potentially amenable to primary intervention, such as workplace hazard exposures, obesity and physical exercise. For example, workplace physical activity interventions have been shown to improve worksite outcomes, such as sick leave.[38] If confirmed, our findings would suggest that primary workforce interventions focusing on lifestyle-related factors may contribute to a reduction in rates of not working three months following injury, as well as contributing to maintaining a healthy and productive workforce.

The strengths of the study include the collection of pre-injury information, large sample size, inclusion of traditionally-conceived 'less severe' non-hospitalised injuries, and the collection and combined multivariable examination of a wide range of potential determinants of work status. Consequently we have found a number of important and previously unreported associations generating new hypotheses for further examination. There are a few limitations to our study. This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently

recall bias might occur. However, workers were specifically directed to consider their pre-injury exposures and few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. The exception to this are the psychosocial factors that may be subject to recall bias. If so, this could have contributed to a lack of relationship between psychosocial factors and not working following injury. The use of single item measures for psychological constructs, such as job satisfaction and optimism, is a potential limitation to this study. However, parsimonious measures have been found to demonstrate good reliability and validity. Furthermore, we were concerned to minimise participant interview burden (the interview took 60 minutes to complete). Recall of the baseline pre-injury work status at the 3 month interview may be subject to recall bias. However, verification of employment status with ACC claims records indicates the likelihood of this is low with 1% of participants having a non-concordant employment status between the self-reported and claims record data. A further limitation is the design of New Zealand's no-fault ~~Accident Compensation Corporation~~ ACC compensation system meaning the findings of this study are potentially not generalisable beyond no-fault compensation systems. However, the no-fault nature of ACC is also a strength of our study. In other injury-compensation systems, where people are required to litigate to gain access to compensation following injury, incentives may exist such that people would be ill-advised to return to work prior to their legal case for compensation coming before the court. Recruiting participants, via the~~The~~ universal no-fault ~~nature of the Accident Compensation Corporation~~ACC scheme ~~also means we cannot~~ does not allow us to examine ~~compensation status~~work status outcome in relation to whether or not people were granted access to ACC. There may be injured New Zealanders, not included in our study, who did not access medical support from a health professional for their injury (a necessary requirement to become registered with ACC), or, who were not referred to ACC by a health professional. There is moderate evidence that the receipt and extent

of compensation has a negative effect upon returning to work following injury in healthcare systems where only certain causes of injury receive compensation, such as those caused by a motor vehicle traffic crash or while at work.[4 39] However, it is a strength of the study that the universal nature of this scheme allows us to examine predictors of work status in the short--term in a broader population context of injury and work than previously examined.

In conclusion, this study indicates a number of pre-injury socio-demographic, occupational and lifestyle factors, as well as injury factors, were associated with not working three months after injury in a sample of New Zealand workers. This study confirms that the predictors of work status following injury are multidimensional and that future studies need to examine a broader range of determinants for work disability. If these findings are confirmed, intervention strategies aimed at identifying workers at increased risk of not working and improving work status in the short-term following injury should address multiple dimensions of the worker and workplace.

Article Summary

Article Focus

- Previous examinations of predictors of work status following injury have focused primarily on hospitalised patients and a limited range of risk factors; this study examines multidimensional predictors of work status three months following hospitalised and non-hospitalised injuries.

Key Message

- While previous findings on socio-demographic and work factors were confirmed, a number of rarely-examined variables were associated with increased odds of not working including:

obesity, temporary employment, long-day work schedules and financial insecurity.

- Contrary to expectations, workers who were infrequent exercisers prior to injury were more likely to be working after injury.
- This study identified a range of potential predictors of not working that, if causal, help identify workers at increased risk of not working three months after injury. If confirmed, intervention strategies should target these groups to reduce short-term work disability.

Strengths and Limitations

- The strengths of the study include the collection of pre-injury information, large sample size, inclusion of non-hospitalised and hospitalised injuries, and the collection and combined multivariable examination of a wide range of potential determinants of work status. Consequently this study has generated new hypotheses for further examination.
- This study relies on self-reported survey data with baseline data collected retrospectively at the time of first interview: consequently recall bias might occur. However, few of the pre-injury variables examined in this analysis are likely to be influenced by their status at the time of interview. The design of New Zealand's universal no-fault injury compensation system may limit the generalisability of study findings beyond similar systems. However, the universal nature of the New Zealand scheme allows the examination of predictors of work status in a broader population context of injury and work than previously examined.

ACKNOWLEDGEMENTS

We are most grateful to the study participants for sharing their information with us. We thank Professor John Langley, Associate Professor Colin Cryer and Natalie Hardaker for helpful comments on an earlier draft of this paper.

FUNDING

This study is funded by the Health Research Council of New Zealand (2007-2013), and was co-funded by the Accident Compensation Corporation, New Zealand (2007-2010) (ID 10/052). Dr Rebbecca Lilley was supported by an Accident Compensation Corporation Early Career Post Doctoral Award (2007-2010) (ID 07/049). The views and conclusions in this paper are the authors' and may not reflect those of the funders.

The funders of this project provided funding for salary and working expenses and had no input in the study design, data collection, data analysis or interpretation with the sole exception of the Accident Compensation Corporation who provided the initial sampling list.

COMPETING INTERESTS

None declared

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